

APPENDIX A

FIELD TESTING

- ITM 506 – Soil Field Moisture Content Determination
- AASHTO T 191 – Density of Soil In-Place by the Sand Cone Method
- AASHTO T 217 – Moisture in Soils by Means of Calcium Carbide Gas Pressure Moisture Tester
- AASHTO T 224 – Correction for Coarse Particles in the Soil Compaction Test
- AASHTO T 255 – Total Evaporable Moisture Content of Aggregate by Drying
- AASHTO T 272 – Family of Curves One Point Method
- AASHTO T 310 – Density of Soil and Soil-Aggregate In-Place by Nuclear Methods

NOTE:

1. Technicians should obtain the latest versions of the official AASHTO test methods and Indiana Test Method (ITM).
2. Technicians should obtain the latest procedural checklists from the “Qualified Laboratory and Technician Program” manual.
3. For some of the listed AASHTO test methods, a training version that was developed by the FHWA through the M-Trac program (CD-August 1999) is available on the INDOT “Y-drive” at “Y:\CRAWFORDSVILLE\Testing\FHWA Soils CD 08-28-02\SOILS.pdf”. This is useful information for hands-on training purposes, but no test questions will be specifically derived from this FHWA CD.

Date: _____

Field Test Number					
Location of Tests	Station				
	Reference to Centerline				
	Elevation or Lift Number				
Compacted Depth of Lift					
Method of Compaction					
Number of Passes with Roller					
Nuclear Gauge	1. Daily Standard Count				
	2. Wet Density From Gauge (0.1 lbs./ft ³)				
	3. Dry Density From Gauge (for information only)				
	4. Percent Moisture from Gauge (for information only)				
	5. Percent Moisture (0.1%) from TD 250				
	6. Dry Density (0.1 lbs./ft ³) line 2 / (1+ (line 5 / 100))				
	7. Adj. Dry Dens. (-No.4) (0.1 lbs./ft ³) line 20 / line 19				
	8. Maximum Dry Density from Lab or 1 Pt. Proctor				
	9. Adjusted % Moisture (-No.4) (0.1%) line 17 x 100				
	10. Optimum Moisture (0.1%)				
	11. Percent Compaction ⁽¹⁾ (1%)				
	12. Percent Compaction Required (1%)				
Test Remarks	Pass/ Fail				
	Lab Sample Number				
	Material Description				
DENSITY CORRECTION (+ No. 4) - AASHTO T 224					
13. Dry Wt. of + No. 4 Material (1g)					
14. Dry Wt. of Total Sample (1g) from TD-250					
15. % of + No. 4 Material (P _c) (0.1%) (line 13/ line 14) x 100					
16. % of - No. 4 Material (P _f) (0.1%) 100 - line 15					
17. Adj. Moist. (M _C) (0.001) (line 5 - (0.02 x line 15)) / line 16					
18. D _f Denominator ₁ (0.01) (line 6 x line 15) / 162.24					
19. D _f Denominator (0.01) 100 - line 18					
20. D _f Numerator (0.1) line 6 x line 16					

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DAILY SUMMARY OF NUCLEAR DENSITY TESTS FOR COMPACTED AGGREGATE

Contract Number _____ Project Number _____ Road Number _____

Date: _____

Field Test Number					
Location of Tests	Station				
	Reference to Centerline				
	Elevation or Lift Number				
Compacted Depth of Lift					
Method of Compaction					
Number of Passes with Roller					
Nuclear Gauge	1. Daily Standard Count				
	2. Wet Density From Gauge (0.1 lbs./ft ³)				
	3. Dry Density From Gauge (for information only)				
	4. Percent Moisture from Gauge (for information only)				
	5. Percent Moisture (0.1%) from TD 250				
	6. Dry Density (0.1 lbs./ft ³) line 2 / (1+ (line 5 / 100))				
	7. Adj. Dry Dens. (-3/4") (0.1 lbs. /ft ³) line 20 / line 19				
	8. Maximum Dry Density from Lab or 1 Pt. Proctor				
	9. Adjusted % Moisture (-3/4") (0.1%) line 17 x 100				
	10. Optimum Moisture (0.1%)				
	11. Percent Compaction (1%) (line 7 / line 8) x 100				
	12. Percent Compaction Required (1%)				
Test Remarks	Pass/ Fail				
	Lab Sample Number				
	Material Description				
DENSITY CORRECTION (+ 3/4") - AASHTO T 224					
13. Dry Wt. of + 3/4" Material (1g)					
14. Dry Wt. of Total Sample (1g) from TD-250					
15. % of + 3/4" Material (P _c) (0.1%) (line 13/ line 14) x 100					
16. % of - 3/4" Material (P _f) (0.1%) 100 - line 15					
17. Adj. Moist. (MC _f) (0.001) (line 5 - (0.02 x line 15)) / line 16					
18. D _f Denominator (0.01) (line 6 x line 15) / 162.24					
19. D _f Denominator (0.01) 100 - line 18					
20. D _f Numerator (0.1) line 6 x line 16					

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INDIANA DEPARTMENT OF TRANSPORTATION
DAILY SUMMARY OF MOISTURE DETERMINATION TESTS

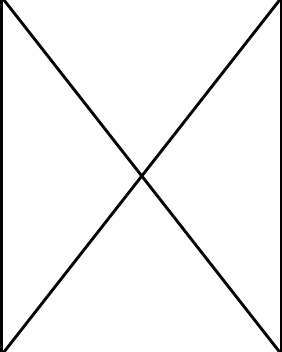
Contract No. _____

Project No. _____

Date: _____

Road No. _____

ITM 506¹

Test Number						Minimum Sample Wt. 1000 g
Station						
1. Wt. of Pan & Wet Material (W1) (1 g)						
2. Wt. of Pan & Dry Material (W2) (1 g)						
3. Weight of Moisture (1 g) Line 1 - Line 2						
4. Weight of Pan (W3) (1 g)						
5. Wt. of Dry Material (1 g) Line 2 - Line 4						
% Moisture (0.1%) (Line 3/ Line 5) x 100						

AASHTO T-255²

Test Number						Minimum Sample Wts.
Station						#8 Stone (ITM 403) ³ 5000 g
1. Weight of Wet Sample (W) (1 g)						#23 Sand (ITM 403) ³ 5000 g
2. Weight of Dried Sample (D) (1 g)						#4 B Borrow 500 g
3. Weight of Moisture (1 g) Line 1 - Line 2						53 Compacted Agg. 4000 g
% Moisture (0.1%) (Line 3/ Line 2) x 100						73 Compacted Agg. 3000 g

¹ ITM 506 defines constant weight as the weight at which further drying at 15 minute intervals does not alter the weight.

² AASHTO 255 defines constant weight as when further heating causes, or would cause, less than 0.1 percent additional loss in weight.

³ ITM 403 defines constant weight as when the sample weight decreases by less than 5 g over 5 minutes of heating.

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DAILY SUMMARY OF SAND IN-PLACE DENSITY TESTS

CONTRACT NO. _____ PROJECT NO. _____ ROAD NO. _____ DATE _____ WEATHER _____

Field Test Number					CONE CORRECTION (C _c)				
Location of Tests	Station				m ₁	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)			
	Reference to Centerline				m ₂	Wt. of Apparatus & Remaining Sand			
	Elevation or Lift Number				C _c	Cone Correction (0.01 lbs.) = m ₁ -m ₂			
Compacted Depth of Lift					BULK DENSITY OF SAND (D _B)				
Method of Compaction					m ₃	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)			
No. of Passes with Roller					m ₄	Wt. of Apparatus & Remaining Sand			
Compacted Material	1. Wet Wt. of Mat. from Hole & Pan (0.01 lbs.)				V _c	Volume of Calibration Container (0.0001ft ³)			
	2. Wt. Of Pan (0.01 lbs.)				D _B	Blk. D. Sand (0.1 lbs./ft ³)= (m ₃ -m ₄ -C _c) / V _c			
	3. Moist Wt. of Mat. (M _{ws}) (0.01 lbs.) line 1- line 2				% MOISTURE - AASHTO T 255 ⁽¹⁾				
	4. Dry Wt. of Mat. (M _{DS}) (0.01 lbs.) line 3 /(1+(MC _T /100))				W	Wt. of Original Sample (1g)			
Sand Cone	5. Initial Wt. of Filled Apparatus (m ₅) (0.01 lbs.)				D	Wt. of Dried Sample (1g)			
	6. Final Wt. of Apparatus & Sand (m ₆) (0.01 lbs.)				MC _T	% Moist.(0.1%) = 100(W - D) / D			
	7. Net Wt. of Sand (0.01 lbs.) line 5 - line 6				+ No. 4 CORRECTION ⁽²⁾				
	8. Wt. of Sand in Hole (0.01 lbs.) line 7 - C _c				16. Dry Wt. of + No. 4 Material (0.01 lbs.)				
	9. Vol. of Test Hole (V _H) (0.0001 ft ³) line 8 / D _B				17. % +No. 4 Mat. (P _c) (0.1%) (line 16 / line 4) x 100				
10. Percent Moisture (0.1%) MC _T or line 19 x 100					18. % - No. 4 Mat. (P _f) (0.1%) 100 - line 17				
11. Proctor Optimum Moisture (0.1%)					19. MC _f (0.001) (MC _T - (0.02 x line 17))/line 18				
12. Dry Density of Material (D _D) (0.1 lb./ft ³) line 4 / line 9 or line 23					20. Dry Density (D _d) (0.1 lbs./ft ³) line 4 / line 9				
13. Proctor Maximum Dry Density (lbs./ft ³)					21. D _f Denominator (0.01) (line 20 x line 17)/162.24				
14. Percent of Maximum Dry Density (1%) (line 12 / line 13) x 100					22. D _f Numerator (0.1) line 20 x line 18				
15. Percent of Maximum Dry Density Required					23. Adj. Dry Den.(D _f) (0.1 pcf) line 22/(100 - line 21)				
Test Remarks	Pass/Fail				Remarks:				
	Lab Sample No.								
	Material Description								

Note 1: AASHTO T 255-Total Evaporable Moisture Content of Aggregate by Drying used for sand & B-Borrow sand.

Note 2: In accordance with AASHTO T 224-Correction for Coarse Particles in the Soil Compaction Test. Assumes a moisture of 2% and a specific gravity of 2.60

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DAILY SUMMARY OF SOIL IN-PLACE DENSITY TESTS

CONTRACT NO. _____ PROJECT NO. _____ ROAD NO. _____ DATE _____ WEATHER _____

Field Test Number					CONE CORRECTION (C_c)				
Location of Tests	Station				m_1	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)			
	Reference to Centerline				m_2	Wt. of Apparatus & Remaining Sand			
	Elevation or Lift Number				C_c	Cone Correction (0.01 lbs.) = $m_1 - m_2$			
Compacted Depth of Lift					BULK DENSITY OF SAND (D_B)				
Method of Compaction					m_3	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)			
No. of Passes with Roller					m_4	Wt. of Apparatus & Remaining Sand			
Soil	1. Wet Wt. of Mat. from Hole & Pan (0.01 lbs.)				V_c	Volume of Calibration Container (0.0001ft ³)			
	2. Wt. Of Pan (0.01 lbs.)				D_B	Blk. D. Sand (0.1 lbs./ft ³) = $(m_3 - m_4 - C_c) / V_c$			
	3. Moist Wt. of Mat. (M_{ws}) (0.01 lbs.) line 1- line 2				% MOISTURE - ITM 506 ⁽¹⁾				
	4. Dry Wt. of Mat. (M_{DS}) (0.01 lbs.) line 3 / $(1 + (MC_T / 100))$				W1	Wt. of Pan & Wet Soil (1g)			
Sand Cone	5. Initial Wt. of Filled Apparatus (m_5) (0.01 lbs.)				W2	Wt. of Pan & Dry Soil (1g)			
	6. Final Wt. of Apparatus & Sand (m_6) (0.01 lbs.)				W3	Wt. of Pan (1g)			
	7. Net Wt. of Sand (0.01 lbs.) line 5 - line 6				MC_T	% Moist. (0.1%) = $((W1 - W2) / (W2 - W3)) \times 100$			
	8. Wt. of Sand in Hole (0.01 lbs.) line 7 - C_c				+ No. 4 CORRECTION ⁽²⁾				
	9. Vol. of Test Hole (V_H) (0.0001 ft ³) line 8 / D_B				16. Dry Wt. of + No. 4 Material (0.01 lbs.)				
10. Percent Moisture (0.1%) MC_T or line 19 x 100					17. % +No. 4 Mat. (P_c) (0.1%) (line 16 / line 4) x 100				
11. Proctor Optimum Moisture (0.1%)					18. % - No. 4 Mat. (P_f) (0.1%) 100 - line 17				
12. Dry Density of Material (D_D) (0.1 lb./ft ³) line 4 / line 9 or Line 23					19. MC_f (0.001) $(MC_T - (0.02 \times \text{line } 17)) / \text{line } 18$				
13. Proctor Maximum Dry Density (lbs./ft ³)					20. Dry Density (D_d) (0.1 lbs./ft ³) line 4 / line 9				
14. Percent of Maximum Dry Density (1%) (line 12 / line 13) x 100					21. D_f Denominator (0.01) (line 20 x line 17)/162.24				
15. Percent of Maximum Dry Density Required					22. D_f Numerator (0.1) line 20 x line 18				
Test Remarks	Pass/Fail				23. Adj. Dry Den. (D_f) (0.1 pcf) line 22/(100 - line 21)				
	Lab Sample No.				Remarks:				
	Material Description								

Note 1: ITM 506-Field Determination of Moisture Content of Soils used for all cohesive soils

Note 2: In accordance with AASHTO T 224-Correction for Coarse Particles in the Soil Compaction Test. Assumes a moisture of 2% and a specific gravity of 2.60

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DAILY SUMMARY OF IN-PLACE DENSITY TESTS (+3/4" Material)

CONTRACT NO. _____ PROJECT NO. _____ ROAD NO. _____ DATE _____ WEATHER _____

Field Test Number					CONE CORRECTION (C_c)						
Location of Tests	Station				m ₁	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)					
	Reference to Centerline				m ₂	Wt. of Apparatus & Remaining Sand					
	Elevation or Lift Number				C _c	Cone Correction (0.01 lbs.) = m ₁ -m ₂					
Compacted Depth of Lift					BULK DENSITY OF SAND (D_B)						
Method of Compaction					m ₃	Wt. of Apparatus Filled w/ Sand (0.01 lbs.)					
No. of Passes with Roller					m ₄	Wt. of Apparatus & Remaining Sand					
Compacted Material	1. Wet Wt. of Material from Hole & Pan (0.01 lbs.)				V _c	Volume of Calibration Container (0.0001ft ³)					
	2. Wt. Of Pan (0.01 lbs.)				D _B	Blk. D. Sand (0.1 lbs./ft ³)= (m ₃ -m ₄ -C _c) / V _c					
	3. Moist Wt. of Mat. (M _{ws}) (0.01 lbs.) Line 1- Line 2				% MOISTURE (AASHTO T255)						
	4. Dry Wt. of Mat. (M _{DS}) (0.01 lbs.) Line 3 / (1+(MC_T / 100))				W	Wt. of Original Sample (1g)					
Sand Cone	5. Initial Wt. of Filled Apparatus (m ₅) (0.01 lbs.)				D	Wt. of Dried Sample (1g)					
	6. Final Wt. of Apparatus & Sand (m ₆) (0.01 lbs.)				MC _T	% Moisture(0.1%) = 100(W - D) / D					
	7. Net Wt. of Sand (0.01 lbs.) Line 5 - Line 6				+ 3/4" CORRECTION⁽¹⁾						
	8. Wt. of Sand in Hole (0.01 lbs.) Line 7 - C_c				16. Dry Wt. of +3/4" Material (0.01lbs.)						
	9. Vol. of Test Hole (V _H) (0.0001 ft ³) Line 8 / D_B				17. % +3/4" Mat.(P _c) (0.1%) (line 16 / line 4) x 100						
10. Percent Moisture (0.1%) Line 19 x 100					18. % -3/4" Mat. (P _f) (0.1%) 100-line 17						
11. Proctor Optimum Moisture (0.1%)					19. MC _f (0.001) (MC_T - (0.02 x line 17)) / line 18						
12. Dry Density of Mat.(D _D) (0.1 lb./ft ³) Line 23					20. Dry Density (D _d) (0.1 lbs./ft ³) line 4 / line 9						
13. Proctor Maximum Dry Density (lbs./ft ³)					21. D _f Denominator (0.01) (line 20 x line 17) / 162.24						
14. Percent of Maximum Dry Density (1%) (Line 12 / Line 13) x 100					22. D _f Numerator (0.1) line 20 x Line 18						
15. Percent of Maximum Dry Density Required					23. Adj. Dry Den.(D _f) (0.1 pcf) line 22/(100 - line 21)						
Test Remarks	Pass/Fail				Remarks:						
	Lab Sample No.										
	Material Description										

Note 1: In accordance with AASHTO T 224-Correction for Coarse Particles in the Soil Compaction Test. Assumes a moisture of 2% and a specific gravity of 2.60.

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INDIANA DEPARTMENT OF TRANSPORTATION
AASHTO T 272-MAXIMUM DENSITY OPTIMUM MOISTURE BY ONE-POINT METHOD

Contract Number _____

Road Number _____

Date _____

Project Number _____

Test Number					
Station					
1. Wet Weight of Compacted Soil & Mold (0.01 lbs.)	Weigh				
2. Weight of Mold (0.01 lbs.)	Weigh				
3. Wet Wt. of Compacted Soil (0.01 lbs.)	Line 1 - Line 2				
4. Wet Density of Compacted Soil (0.1 lbs./ft ³)	Line 3 x 30				
Percent Moisture (0.1%)	ITM 506				
Maximum Dry Density (0.1 lbs./ft ³)	From Curve				
Optimum Moisture Percent (0.1%)	From Curve				
Curve Number	From Curve				

ITM 506

1. Wt. of Pan & Wet Soil (W1) (1g)	Weigh				
2. Wt. of Pan & Dry Soil (W2) (1g)	Weigh				
3. Wt. of Moisture (1g)	Line 1 - Line 2				
4. Wt. of Pan (W3) (1g)	Weigh				
5. Wt. of Dry Material (1g)	Line 2 - Line 4				
% Moisture (0.1%)	Line 3 / Line 5 x 100				

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